

History and Regulation of Wind Energy in America

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As of 2022, energy from fossil fuels made up 79% of the energy consumed in the United States.¹ Nuclear energy was used for 8% of America's energy, and renewable sources produced 13.1%.² Fossil fuel energy and nuclear energy have been linked to numerous environmental issues such as air pollution, global climate change, and radioactive waste.³ Renewable sources of energy include wind energy, hydroelectric energy, geothermal energy, biomass energy, and solar energy.⁴ This blog will focus on the development of wind energy in America, as well as how the use of wind energy is regulated.

In 1850, the U.S. Wind Engine Company was started by Daniel Halladay and John Burnham.⁵ They designed the Halladay Windmill for use in Western America.⁶ Halladay's Wind Wheel was patented in 1854, in which it was described:

[W]ings or sails attached to movable or rotating spindles having levers or equivalent devices connected to them, said levers or equivalents being also connected to a head which rotates with the wings or sails and upon the same shaft, the head having a lever connected to it, which is operated by a governor which slides the head upon the shaft and causes the levers or their equivalents to turn the wings or sails so as to present a proper resisting-surface to the wind, and thereby produce a uniform velocity of the wings or sails, which are made to have a greater or less obliquity, according to the velocity of the wind.⁷

In its early days, North American farmers utilized wind power for irrigation purposes, and windmills powered homes and businesses.⁸ Windmills continued to develop over time, and, by

¹ *U.S. Renewable Energy Factsheet*, UNIV. OF MICH., <https://css.umich.edu/publications/factsheets/energy/us-renewable-energy-factsheet> (last visited Sept. 15, 2024) [<https://perma.cc/KFF6-FF39>].

² *Id.*

³ *Id.*

⁴ *Id.*

⁵ *History of U.S. Wind Energy*, OFF. OF ENERGY EFFICIENCY & RENEWABLE ENERGY, <https://www.energy.gov/eere/wind/history-us-wind-energy> (last visited Sept. 15, 2024) [<https://perma.cc/8RKP-8S5Z>].

⁶ *Id.*

⁷ U.S. Patent No. 0011629A (dated August 29, 1854).

⁸ *U.S. Renewable Energy Factsheet*, *supra* note 1.

1890, the efficiency of the windmill design was improved through the invention of steel blades.⁹ Windmills spread across the country as people moved west.¹⁰

The Chicago World's Fair in 1893 allowed for various wind companies to show their wind turbine designs.¹¹ "Grandpa's Knob" was the largest wind turbine of 1941, and it powered a local utility network in Vermont during World War II.¹² Designed by Palmer Putnam, G.E., and the Morgan Smith Company, this was the first megawatt-scale wind turbine.¹³ Use of this wind turbine, also known as a Smith-Putnam turbine, "was the first time ever wind power fed the high-voltage lines of a utility system."¹⁴ "Grandpa's Knob" was used for 5 years until a blade broke off of the turbine and use was stopped.¹⁵

In 1978, the Public Utility Regulatory Policies Act was signed, "which require[d] companies to buy a certain amount of electricity from renewable energy sources, including wind."¹⁶ In 1980, large wind farms were installed in California, leading to development of designs to lessen environmental effects.¹⁷

In 1981, Larry Viterna and Bob Corrigan, NASA Scientists, developed a method to predict the performance of wind turbines, and, in 1992, the Energy Policy Act authorized tax credits for use of wind energy.¹⁸ In 1993, The National Wind Technology Center was built to be a center for wind energy technology research.¹⁹ In 2008, the U.S. Department of Energy reported that 20% of energy would be wind energy by 2030.²⁰

The U.S. Department of Energy and Department of the Interior and released their National Offshore Wind Strategy.²¹ The goal was to reduce energy costs, and three offshore wind demonstration projects were picked to be a part of their \$168 million initiative.²² Wind energy was moved offshore for the first time in 2013 with a grid-connected offshore wind turbine.²³ The Block

⁹ *Id.*

¹⁰ *Id.*

¹¹ *Id.*

¹² *Id.*

¹³ Dan Reicher, *Grampa's Knob 75th Anniversary*, VERMONT PUBLIC (Oct. 16, 2016, 4:09 PM), <https://www.vermontpublic.org/programs/2016-10-19/reicher-grampas-knob-75th-anniversary> [<https://perma.cc/8ULN-P24K>].

¹⁴ *Id.*

¹⁵ *Id.*

¹⁶ *U.S. Renewable Energy Factsheet*, *supra* note 1.

¹⁷ *Id.*

¹⁸ *Id.*

¹⁹ *Id.*

²⁰ *Id.*

²¹ *Id.*

²² *Id.*

²³ *Id.*

Island Wind Farm became the first offshore U.S. windfarm in 2016.²⁴ By 2019, the wind energy produced in America was enough to power 28 million homes.²⁵

The change in wind turbines over time is reflected in the patent descriptions. In an abstract for a more recent patent for offshore wind turbines, methods for deploying, and for installing, the invention was described as follows:

An offshore wind turbine includes a ballast adjustable hull. In addition, the offshore wind turbine includes a telescopic tower movably coupled to the hull. The tower has a central axis and comprises a plurality of nested concentrically arranged elongate tubulars. Further, the offshore wind turbine includes a ballast adjustable elevator disposed about the telescopic tower and movably coupled to the hull. The elevator is configured to lift one or more of the plurality of tubulars of the tower axially upward relative to the hull. Still further, the offshore wind turbine includes a nacelle coupled to an upper end of one of the plurality of tubulars of the tower. Moreover, the offshore wind turbine includes a rotor assembly coupled to the nacelle.²⁶

The description of this wind turbine, in comparison to the description of the Halladay Wind Wheel, shows greater complexity and adaptation for use in a different location.

Wind energy technology was pushed forward through funding provided by the U.S. Department of Energy's Wind Energy Technologies Office (WETO) and other offices within the Department of Energy.²⁷ The U.S. Patent system requires applicants to acknowledge government funding received that was related to their invention.²⁸ WETO funded 114 U.S. wind energy patents between 1976 and 2018.²⁹ These patents were classified in numerous groups, including wind turbine blades, wind turbine generators, wind turbine control, wind turbine nacelles, wind turbine manufacture, and controlling blade pitch.³⁰ Wind energy patents obtained by other leading companies, such as G.E., Vestas, and Siemens were linked to previous Department of Energy

²⁴ *Id.*

²⁵ *Id.*

²⁶ U.S. Patent No. 12078146B2 (filed Apr. 26, 2019).

²⁷ *The Influence of Wind Energy Patents Funded by the U.S. Department of Energy's Wind Energy Technologies Office and Other DOE Offices*, 1790 ANALYTICS LLC, at i (2021). <https://www.energy.gov/sites/default/files/2021-07/WETO%20wind%20energy%20patent%20study%20final%20report%20jun2021.pdf>.

²⁸ *Id.* at 1.

²⁹ *Id.* at i, 10.

³⁰ *Id.* at 20.

funded patents,³¹ which shows that the research done by the Department of Energy allows others to improve their technology as well.

Through the growth and development of wind energy, important ordinances, zoning laws, and permitting have been established.³² These types of regulations offer different aspects of control in the placement, installation, and use of windfarms. An ordinance provides control to local government, and a wind energy ordinance would speak specifically to local needs and preferences for use of wind turbines.³³ Zoning allows local government to regulate how an owner uses their private land to protect the public's health, safety, and welfare.³⁴ This means that a local government controls whether a person is allowed to install wind turbines.³⁵ Permitting allows local governments to be involved in the installation of wind turbines.³⁶ "Permits are usually granted in accordance to the provisions of the ordinance regulating the development of wind systems."³⁷

Ordinances cover characteristics of wind turbines such as height, moratorium, noise, setback, and utility-scale ban.³⁸ An example of such an ordinance can be found in the Marin County Code § 22.32.180(B)(5), which shows the height requirements and setback requirements for Wind Energy Conversion Systems (WECS).³⁹ The Baldwin County Zoning Ordinance Sec. 13.13 shows how WECS can be characterized based on their capacity and then permitted in different areas based on how much electrical energy they generate.⁴⁰ The number of WECS units, the size of the lot, and the zoning of the lot are also considerations under this ordinance.⁴¹

WETO provided a wind energy report in which predictions for what wind energy could look like and accomplish by 2050 were made.⁴² It was found that wind could be a feasible source

³¹ *Id.* at 22.

³² *Small Community Wind Handbook*, WINDEXCHANGE, <https://windexchange.energy.gov/small-community-wind-handbook> (last visited Sept. 14, 2024) [<https://perma.cc/88SE-CZCM>].

³³ *Id.*

³⁴ *Id.*

³⁵ *Id.*

³⁶ *Id.*

³⁷ *Id.*

³⁸ *Wind Energy Ordinances*, WINDEXCHANGE, <https://windexchange.energy.gov/projects/ordinances> (last visited Sept. 15, 2024) [<https://perma.cc/ZZ6X-NJUX>] ("A setback distance is the minimum allowable distance between a wind turbine and a designated area of concern. . ."). ("A wind energy ban could include prohibiting wind energy development in the expressed area, such as by limiting project output capacity (expressed in MW or kW), or by restricting the offsite use of the electricity generated.")

³⁹ Marin County Code § 22.32.180(B)(5) (2021), https://library.municode.com/ca/marin_county/codes/municipal_code?nodeId=TIT22DECO_ARTIISIPLGEDERE_CH22.32STSPLAUS [<https://perma.cc/8ZGT-3WHT>]; *See also Wind Energy Ordinances*, *supra* note 38.

⁴⁰ Baldwin County Zoning Ordinance § 13.13 (2018), <https://www.aqualisco.com/wp-content/uploads/2019/08/Baldwin-County-Zoning-Ordinances.pdf>; *See also Wind Energy Ordinances*, *supra* note 38.

⁴¹ *Id.*

⁴² *Wind Vision: A New Era for Wind Power in the United States*, OFF. OF ENERGY EFFICIENCY & RENEWABLE ENERGY. <https://www.energy.gov/eere/wind/wind->

of electricity in every state and “is anticipated to save consumers \$280 billion by 2050.”⁴³ Wind energy was found to have the potential to avoid emission of over 12 gigatonnes of greenhouse gases and save 260 billion gallons of water.⁴⁴

In conclusion, the development of wind energy over time has led to an increase in power produced by wind energy. Through the changing landscape of wind energy use in America, the design of windmills, wind turbines, and other wind energy conversion systems has changed to adapt to new locations and to produce more power. To couple with the growth of wind energy, local governments have worked to regulate their use, location, height, and other factors that could impact local communities.

vision#:~:text=The%20Wind%20Vision%20Report%20shows,and%20supporting%20services%20by%202050 (last visited Sept. 18, 2024) [<https://perma.cc/J9ES-5NL2>].

⁴³ *Id.*

⁴⁴ *Id.*